

New Species of *Leptohyphes* Eaton

(Ephemeroptera: Tricorythidae)

RICHARD K. ALLEN

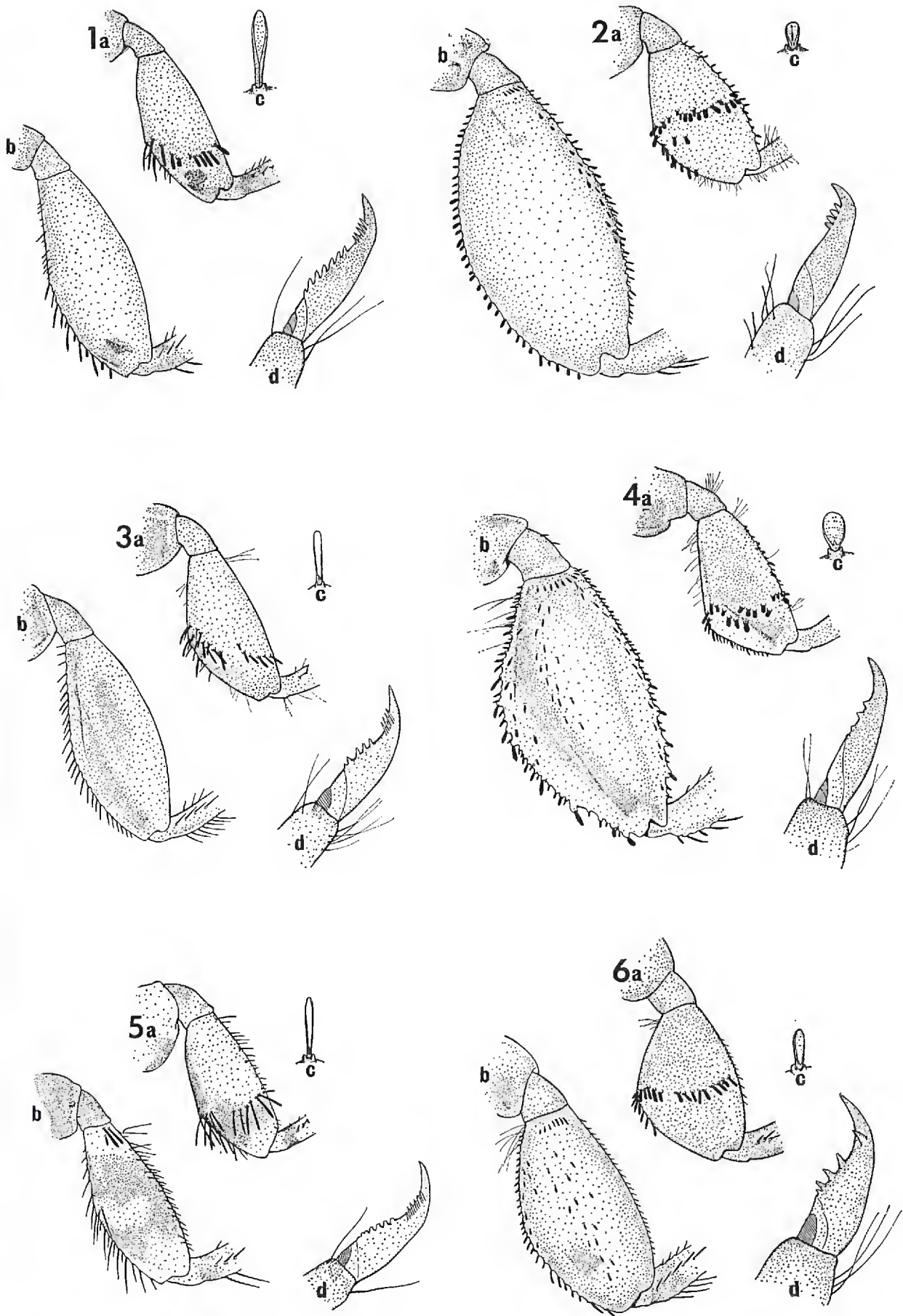
California State University, Los Angeles

Collections of *Leptohyphes* nymphs from the University of Utah, Salt Lake City, and Florida A. & M. University, Tallahassee, include ten undescribed species. Grateful acknowledgment is made to G. F. Edmunds, Jr. and W. L. Peters for loan of the material and for permission to publish names and descriptions of the species.

***Leptohyphes edmundsi* Allen, new species**

NYMPH. Length: body 4.0–5.0 mm; caudal filaments 3.0–4.0 mm. General color light brown to brown with dark brown and black markings. Head light brown with black markings; vertex light brown; head with narrow black stripe from posterior margin of compound eyes to posterior margin of head then mesad along posterior margin to near epicranial suture; transverse black band on frons between lateral ocelli; lateral ocelli small; maxillary palpi 2-segmented. Thoracic nota light brown with variable black maculae; legs light brown to pale with black markings; femora with subapical black macula (fig. 1a–b); femora with moderately long spines (fig. 1c); fore femoral band of spines as in fig. 1a; hind femora 30 percent longer than fore femora; anterior surface of middle and hind femora without spines; ventral (leading) margin of middle and hind femora without spines; dorsal margin of femora with long spines (fig. 1b); tibiae light brown with brown subbasal transverse band; tarsi light brown with brown transverse band near base; tarsal claws with 6–7 marginal denticles, and palisade of 4–5 submarginal denticles near apex (fig. 1d). Abdominal terga 1–9 brown with dark brown markings which are separated by median brown longitudinal stripe; terga 1–6 with sublateral black maculae mesad to gills (fig. 19); operculate gills brown with dark brown mark at base and pale apically; gills without apical spine (fig. 11); abdominal sterna brown to dark brown, often with dark brown lateral margins. Caudal filaments light brown.

HOLOTYPE, MATURE NYMPH, RIO CATIRAS, MORRETES, PARANA, BRAZIL, IV-65, F. Plaumann, in collection University of Utah, Salt Lake City. Paratopotypes: 20 nymphs, same data as holotype, 2 nymphs each in collections of California State University, Los Angeles; California Academy of Sciences, San Francisco; and Canadian National Collection, Ottawa; Smithsonian Institution, Washington D. C.; and Florida A. & M. University, Tallahassee, others in collection of University of Utah. Paratypes: 23 nymphs, Rio Warnow, Santa Catarina, Brazil, XI-65, F. Plaumann; 8 nymphs, Arroio Irapua, Rio Grande do Sul, Brazil, XI-65, F. Plaumann; 2 nymphs, Rio Cubatao, Santa Catarina, Brazil, XI-65, F. Plaumann; 2 nymphs, Rio das Cobras, Parana, Brazil, III-65, F. Plaumann; 8 nymphs, Rio Cavallinha, Santa Catarina, Brazil, XI-65, F. Plaumann; 21 nymphs, Arroio do Hilario, Rio Grande do Sul, Brazil, XI-65, F. Plaumann. All paratypes in collection University of Utah.



FIGS. 1-6. *Leptohyphes* nymphs, leg parts: (a) fore femur; (b) hind femur; (c) femoral spine; (d) tarsal claw. fig. 1, *L. edmundsi*; fig. 2, *L. carinus*; fig. 3, *L. flinti*; fig. 4, *L. pupulus*; fig. 5, *L. tinctus*; fig. 6, *L. invictus*.

This species is named in honor of George F. Edmunds, Jr., University of Utah, in recognition of his many contributions to our knowledge of mayfly taxonomy. *Leptohyphes edmundsi* is easily distinguished from the other described nymphs of South American *Leptohyphes* by the distinctive markings on the abdominal terga, the legs, and the abdominal gills, and by the number and arrangement of the denticles on the tarsal claws.

***Leptohyphes carinus* Allen, new species**

NYMPH. Length: body 3.5–4.5 mm; caudal filaments broken. General color brown with black markings. Head brown with narrow black stripe from posterior margin of compound eyes to posterior margin of head; lateral ocelli small; maxillary palpi 3-segmented. Thoracic nota brown with irregular black markings; legs unicolorous brown; femora with short spines (fig. 2c); fore femoral band of spines as in fig. 2a; hind femora 50 percent longer than fore femora; anterior surface of middle and hind femora with row of transverse spines at base; dorsal and ventral margins of middle and hind femora with numerous moderately long spines in elevated sockets (fig. 2b); tibiae and tarsi with long setae; tarsal claws with 4 blunt marginal denticles near apex (fig. 2d). Abdominal terga 1–3 brown with black transverse bands; terga 4–10 unicolorous brown; terga 4–9 with a round, median tubercle; operculate gills pale, black at base (fig. 12); gills with apical spine; abdominal sterna brown. Caudal filaments broken.

HOLOTYPE, MATURE NYMPH, GUYUMBA, 21 km. dc TINGO MARIA, HUALLAGA, PERU, 25-IX-63, M. Pandura, in collection University of Utah, Salt Lake City.

Leptohyphes carinus is superficially close to *L. tuberculatus* Allen as the nymphs of both bear a median row of dorsal abdominal tubercles. They are distinguished as the former lacks a tubercle at the apex of the hind femur. These species are further distinguished by the coloration of the operculate gills, the dentition on the tarsal claws, and the armature on the legs and body.

***Leptohyphes flinti* Allen, new species**

NYMPH. Length: body 3.0–4.0 mm; caudal filaments 2.5–3.5 mm. General color pale to brown and suffused with black. Head brown with black stripe on frons between lateral ocelli; lateral ocelli small; maxillary palpi 3-segmented. Thoracic nota pale to brown, suffused with black, and with complex black pattern; legs yellow; femora with moderately long spines (fig. 3c), fore femoral band of spines as in fig. 3a; hind femora 30 percent longer than fore femora; anterior surface of middle and hind femora without spines; ventral (leading) margin of middle and hind femora without spines; dorsal margin of middle and hind femora with long spines (fig. 3b); tarsal claws with 3–5 marginal denticles, and palisade of 4–5 submarginal denticles near apex (fig. 3d). Abdominal terga pale to brown and suffused with black; operculate gills brown and suffused with black, margins pale (fig. 13); gills without apical spine; abdominal sterna brown. Caudal filaments brown.

HOLOTYPE, MATURE NYMPH, SPRINGFIELD EST., DOMINICA, 26-VII-63, O. S. Flint, in collection University of Utah, Salt Lake City. Paratopotypes: 6 nymphs, same data as holotype, 2 in collection California State University, Los Angeles and 2 in collection University of Utah, and 2 in collection Smithsonian Institution.

This species is named in honor of Oliver S. Flint, Jr., Smithsonian Institution, Washington, D. C., the collector of the type material. There are two other species of *Leptohyphes* now known from the West Indies, and *L. flinti* is distinguished from these, and all others in the genus, by the following combination of characters: (1) by the coloration of the abdomen, legs, and gills; (2) by the length of the femoral spines; and (3) by the number and arrangement of the denticles on the tarsal claws.

Leptohyphes populus Allen, new species

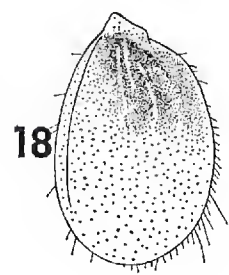
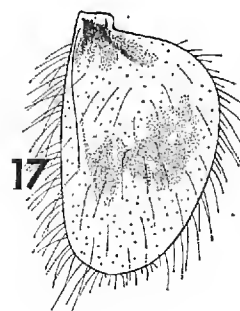
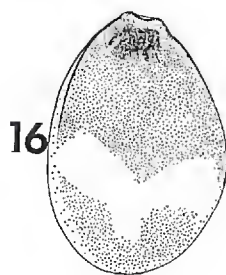
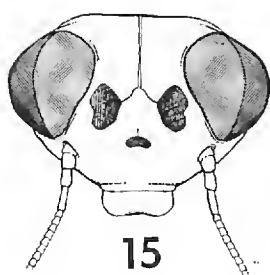
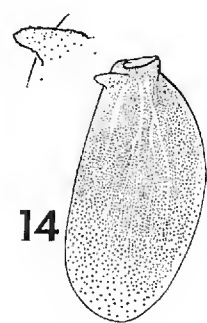
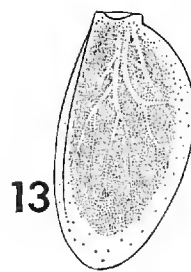
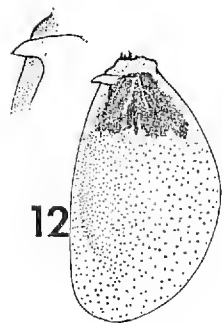
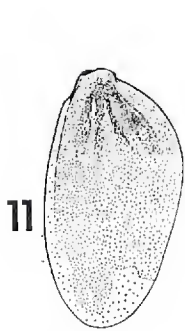
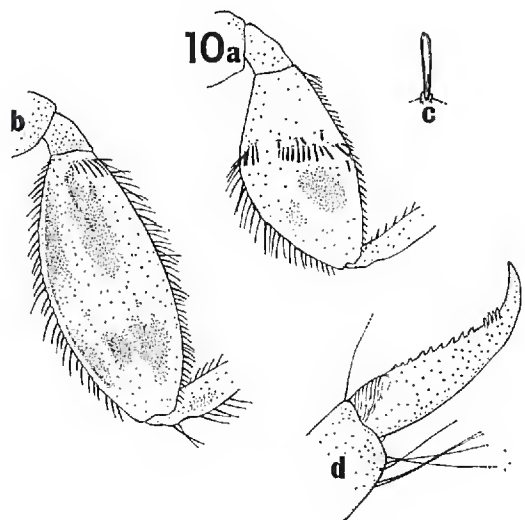
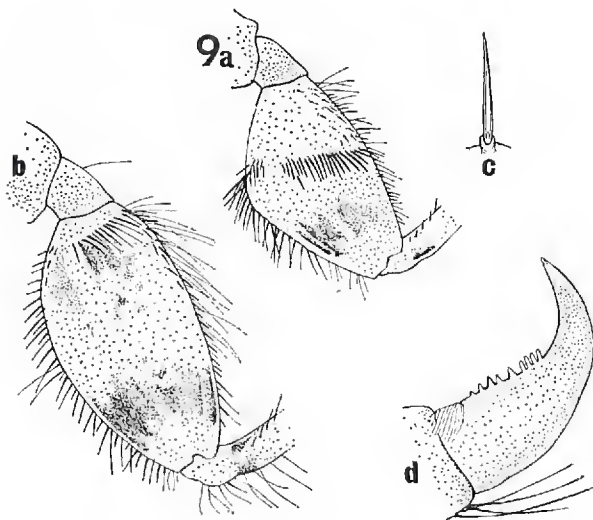
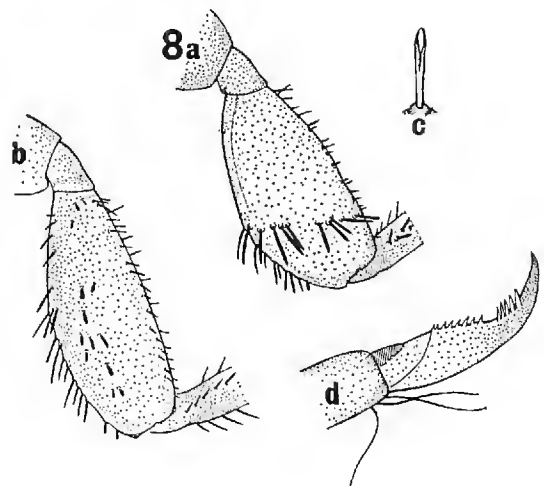
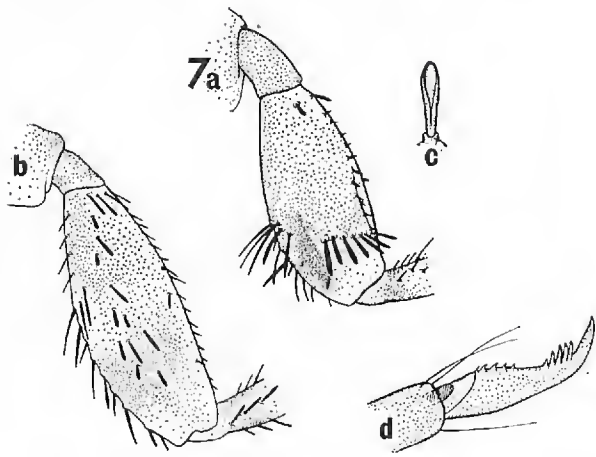
NYMPH. Length: body 4.0–5.0 mm; caudal filaments 4.0–5.0 mm. General color brown with dark brown markings. Head brown with dark brown markings on vertex and frons between lateral ocelli; compound eyes large, divided in male (fig. 15); compound eyes two-colored, outer portion black, inner portion brown; lateral ocelli large; maxillary palpi 3-segmented. Thoracic nota brown with dark brown markings; legs brown; femora with short, heavy spines (fig. 4c); fore femoral band of spines as in fig. 4a; marginal spines of hind femora in elevated sockets (fig. 4b); hind femora 45 percent longer than fore femora; anterior surface of middle and hind femora with spines; dorsal and ventral margins of middle and hind femora with spines (fig. 4b); tibiae and tarsi brown; tarsal claws with 3–4 marginal denticles (fig. 4d). Abdominal terga brown, suffused with black and with dark brown spots; abdominal terga 6–8 with dark brown transverse band on posterior margin; operculate gills light brown, suffused with black, gills with apical spine (fig. 14); abdominal sterna brown. Caudal filaments light brown.

HOLOTYPE, MATURE MALE NYMPH, RIO MARAUIA, 3 days above SAN ANTONIO MISSION, NW. TAPARUQUARA, AMAZONAS, BRAZIL, 26/27-I-63, F. J. Fittkau, in collection University of Utah, Salt Lake City.

Leptohyphes pupulus is the first species in which the male nymph is known to possess divided compound eyes. It is distinguished from all other described South American species by this character, and by the combination of the dorsal abdominal color pattern, the number,

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FIGS. 7–10. *Leptohyphes* nymphs, leg parts: (a) fore femur; (b) hind femur; (c) femoral spine; (d) tarsal claw. fig. 7, *L. minimus*; fig. 8, *L. viriosus*; fig. 9, *L. jamaicanus*; fig. 10, *L. rolstoni*. FIGS. 11–18. body parts: fig. 11, gill, *L. edmundsi*; fig. 12, gill, *L. carinus*; fig. 13, gill, *L. flinti*; fig. 14, gill, *L. pupulus*; fig. 15, head, *L. pupulus*; fig. 16, gill, *L. viriosus*; fig. 17, gill, *L. jamaicanus*; fig. 18, gill, *L. rolstoni*.



shape, and arrangement of the denticles on the tarsal claws, and by having elevated spines on the hind femora.

***Leptohyphes tinctus* Allen, new species**

NYMPH. Length: body 3.0–4.0 mm; caudal filaments broken. General color pale with brown markings. Head pale with brown markings; head with paired brown maculae on occiput mesad of compound eyes; frons brown except pale around median ocellus and bases of antennae; lateral ocelli small; maxillary palpi 2-segmented, apical segment with terminal seta. Thoracic nota pale with small black maculae; pronotum pale; mesonotum with pale median macula between base of wing pads; legs pale with brown markings; femora pale at base and with median brown macula (fig. 5a–b); femora with long spines (fig. 5c); fore femoral band of spines as in fig. 5a; hind femora 10 per cent longer than fore femora; anterior surface of middle and hind femora with 3–5 long spines near base (fig. 5b); dorsal and ventral margins of middle and hind femora with long spines (fig. 5b); tibiae pale with subbasal and subapical transverse bands; tarsal claws with 6–8 marginal denticles and palisade of 5–7 submarginal denticles near apex (fig. 5d). Abdominal terga pale with brown and black maculae as in fig. 20; operculate gills pale with brown markings (fig. 20); gills without apical spine; abdominal sterna pale with brown lateral margins and paired sublateral black maculae. Caudal filaments pale with brown annulations.

HOLOTYPE, MATURE NYMPH, RIO IVAY, RIO GRANDE DO SUL, BRAZIL, XI-65, F. Plaumann, in collection University of Utah, Salt Lake City.

This species is most easily distinguished by the distinctive color pattern on the abdominal terga and operculate gills.

***Leptohyphes invictus* Allen, new species**

NYMPH. Length: body 2.5–3.5 mm; caudal filaments 2.0–3.0 mm. General color light brown with brown markings; head light brown with an irregular, large, dark brown macula on frons; head with fine spicules; lateral ocelli small; maxillary palpi 3-segmented. Thoracic nota light brown with irregular dark brown maculae; nota with fine spicules; legs light brown with apical brown tibial and tarsal bands; femora with moderately long spines (fig. 6c); fore femoral band of spines as in fig. 6a; hind femora 20 percent longer than fore femora; anterior surface of middle and hind femora with short spines (fig. 6b); ventral (leading) margin of middle and hind femora with short spines; dorsal margin of middle and hind femora with long spines (fig. 6b); tarsal claws with 2–3 marginal denticles and 1 submarginal denticle near apex (fig. 6d). Abdominal terga light brown; posterior margins of terga 2–9 with long spines; operculate gills light brown, dark near apex as in fig. 12; gills without apical spines; abdominal sterna pale. Caudal filaments pale.

HOLOTYPE, MATURE NYMPH, TULUMAYO, 29 KM. E. TINGO MARIA, SAN MARTIN PROVINCE, PERU, 23-VI-63, W. L. Peters, in collection University of Utah, Salt Lake City. Paratopotypes: 2 nymphs, same data as holotype, 1 each in collections California State University, Los Angeles, and University of Utah.

This species is distinguished from others described from South Amer-

ica by the arrangement and degree of development of the spines on the fore femora, and by the arrangement of the denticles on the tarsal claws.

***Leptohyphes minimus* Allen, new species**

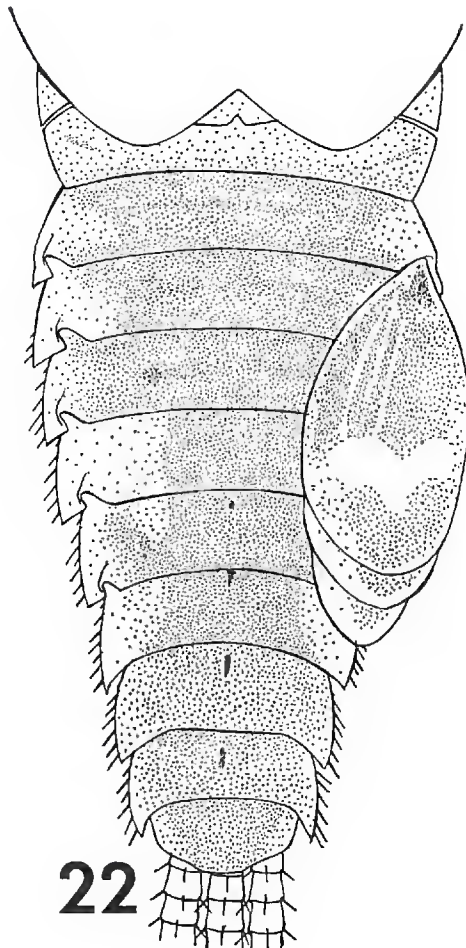
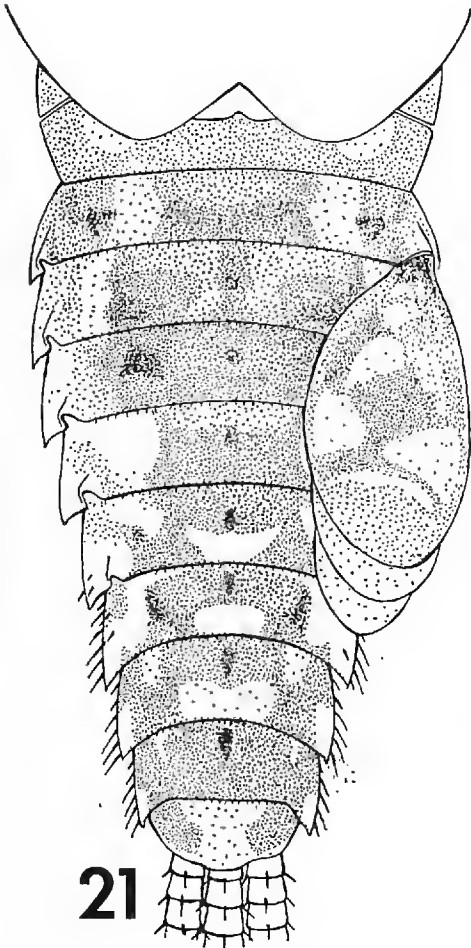
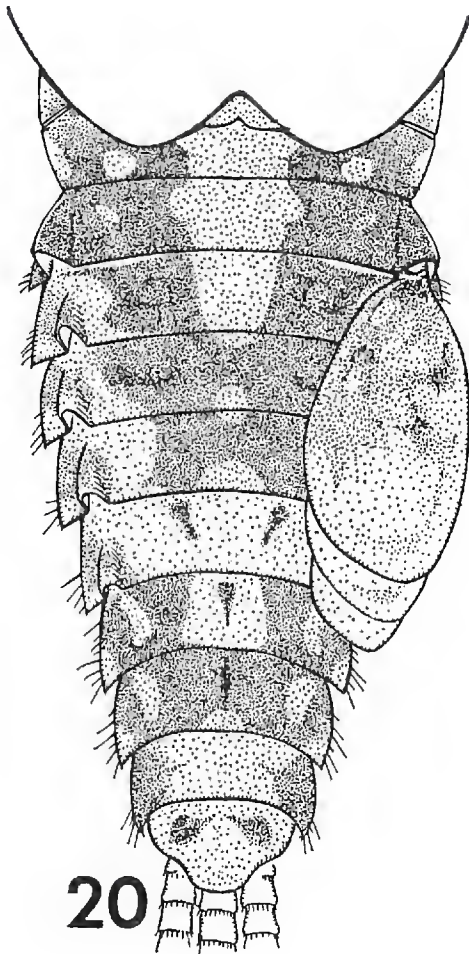
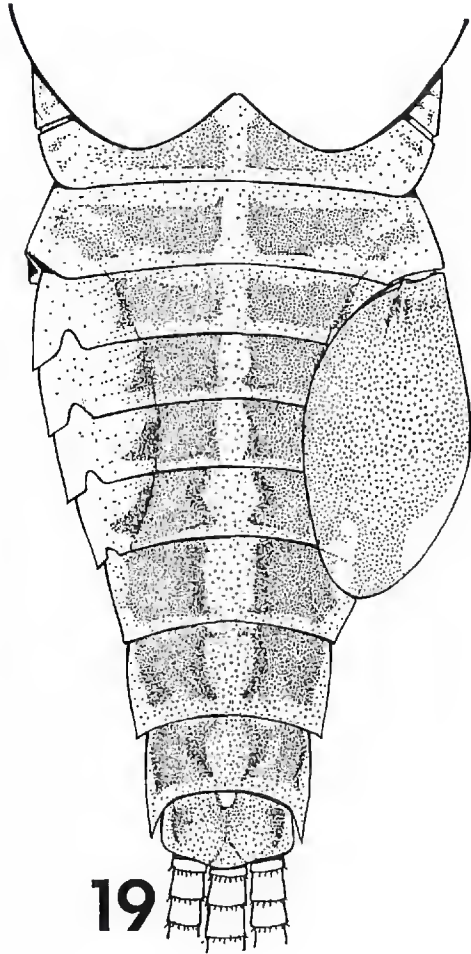
NYMPH. Length: body 2.0–3.0 mm; caudal filaments broken. General color brown with dark brown and black markings. Head brown with a pale transverse band on vertex between compound eyes; lateral ocelli small; maxillary palpi 2-segmented, apical segment with terminal seta. Thoracic nota brown with pale and black markings; pronotum brown with irregular black markings and black posterior margin; mesonotum brown with two sets of paired median pale maculae, and black lateral margins; legs brown with pale markings; femora light brown with brown subapical mark and pale apically (fig. 7a–b); femora with moderately long spines (fig. 7c); fore femoral band of spines as in fig. 7a; hind femora 10 percent longer than fore femora; anterior surface of middle and hind femora with long spines (fig. 7b); ventral (leading) margin of middle and hind femora with moderately long spines; dorsal margin of middle and hind femora with long spines; tibiae brown with subbasal and subapical brown bands; tarsi with median brown band; tarsal claws with 5–7 marginal denticles and palisade of 5–6 denticles near apex (fig. 7d). Abdominal terga brown with pale and black maculae; terga 1–8 with pale submedian and black sublateral maculae; terga 3–8 with black median macula; tergum 10 pale with paired lateral brown maculae (fig. 21); operculate gills brown with pale markings and pale transverse line near middle of lamellae (fig. 21); gills without apical spine; abdominal sterna brown. Caudal filaments brown.

HOLOTYPE, MATURE NYMPH, ARROIO LAGEADO, RIO GRANDE DO SUL, BRAZIL, XI-64, F. Plaumann, in collection University of Utah, Salt Lake City. Paratypes: 7 nymphs, same data as holotype, 3 in collection California State University, Los Angeles, and 4 in collection University of Utah.

Leptohyphes minimus is distinguished from all other nymphs of the genus by its small size, and distinctive color patterns on the abdominal terga and tracheal gills.

***Leptohyphes viriosus* Allen, new species**

NYMPH. Length: body 3.0–4.0 mm; caudal filaments broken. General color pale with brown and black markings. Head pale with brown markings; occiput with paired brown maculae mesad to compound eyes; frons brown except pale around median ocellus and bases of antennae; lateral ocelli small; maxillary palpi 2-segmented, apical segment with terminal seta. Thoracic nota pale with small black maculae; legs brown with darker brown markings; femora brown; femora with long spines (fig. 8c); fore femoral band of spines as in fig. 8a; hind femora 10 percent longer than fore femora; anterior surface of middle and hind femora with spines (fig. 8b); ventral (leading) margin of middle and hind femora with moderately long spines; dorsal margin of middle and hind femora with long spines (fig. 8b); tibiae pale with brown transverse bands; tarsal claws with 6–8 marginal denticles, and palisade of 5–6 submarginal denticles near apex (fig. 8d). Abdominal terga brown with pale maculae and black spots; terga 2–7 with pale lateral margins; terga 6–9 with median black spot (fig. 22); operculate gills



brown, dark brown at apex, and with pale heart-shaped maculae near base; gills without apical spine (fig. 16); abdominal sterna pale with brown lateral margins and paired sublateral black maculae. Caudal filaments pale with brown annulations.

HOLOTYPE, MATURE NYMPH, RIO IVAY, RIO GRANDE DO SUL, BRAZIL, XI-64, F. Plaumann, in collection University of Utah, Salt Lake City.

This species is most easily recognized by the distinctive heart-shaped macula on the operculate gills, and it may be distinguished from all other described species by the color pattern on the abdominal terga, the length, shape and arrangement of the femoral spines, and the arrangement of the dentition on the tarsal claws.

***Leptohyphes jamaicanus* Allen, new species**

NYMPH. Length: body 4.0–5.0 mm; caudal filaments 3.0–4.0 mm. General color pale with black markings. Head pale with black dots on vertex and black marking on frons between compound eyes; lateral ocelli small; maxillary palpi 3-segmented, and with long apical spine. Thoracic nota pale with complex black pattern; legs pale with black markings; fore femora pale with black subapical band (fig. 9a); middle and hind femora pale, black at base and with black subapical band (fig. 9b); femora with long sharp spines (fig. 9c); fore femoral band of spines as in fig. 9a; hind femora 30 percent longer than fore femora; anterior surface of middle and hind femora with row of spines near base (fig. 9b); dorsal and ventral margins of middle and hind femora with spines; tibiae pale with black transverse band near base; tarsi pale; tarsal claws with 7–9 marginal denticles (fig. 9d). Abdominal terga 1–10 each with median black transverse band and pale lateral margins; operculate gills nearly triangular in shape (fig. 17); gills pale with black markings; gills without apical spines; abdominal sterna pale. Caudal filaments pale.

HOLOTYPE, MATURE NYMPH, CLARENDON, RIO MINHO, 1 MI. E. FRANKFIELD, JAMAICA, 6-III-63, T. H. FAIR & A. Barrett, in collection Florida A. & M. University, Tallahassee.

This is only one of three species of *Leptohyphes* known from the West Indies and it is distinguished from the others by the distinctive black markings on the body and legs. It is further distinguished from these, and all other species, by the shape of the operculate gills, the shape and degree of development of the femoral spines, and by the dentition on the tarsal claws.

***Leptohyphes rolstoni* Allen, new species**

NYMPH. Length: body 4.0–5.0 mm; caudal filaments 2.0–3.0 mm. General color pale to light brown with black markings. Head light brown with black

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FIGS. 19–22. *Leptohyphes* nymphs, abdomens: fig. 19, *L. edmundsi*; fig. 20, *L. tinctus*; fig. 21, *L. minimus*; fig. 22, *L. viriosus*.

markings; vertex and occiput with penciled black markings; frons with black marking between compound eyes and lateral black markings from compound eyes anterior to clypeus; lateral ocelli small; maxillary palpi 3-segmented. Thoracic nota pale to light brown with variable black markings; legs pale with black markings; fore femora pale with black apical macula (fig. 10a); middle and hind femora pale with black markings as in fig. 10b; femora with moderately long spines (fig. 10c); fore femoral band of spines as in fig. 10a; hind femora 25 percent longer than fore femora; anterior surface of middle and hind femora with row of spines near base (fig. 10b); dorsal and ventral margins of middle and hind femora with spines (fig. 10b); tibiae and tarsi pale; tarsal claws with 7-9 small marginal denticles, and palisade of 4-5 submarginal denticles near apex (fig. 10d). Abdominal terga pale with black transverse band on each segment, band interrupted medially on segments 9-10; operculate gills pale with large black macula at base (fig. 18); gills without apical spine; abdominal sterna pale. Caudal filaments pale.

HOLOTYPE, MATURE NYMPH, SAN CRISTOBAL, DOMINICAN REPUBLIC, 5-IX-66, L. H. Rolston, in collection Florida A. & M. University, Tallahassee. Paratopotypes: 35 nymphs, same data as holotype, 5 nymphs each in collections California State University, Los Angeles and University of Utah, Salt Lake City, remainder in collection Florida A. & M.

This is the first *Leptohyphes* to be described from the Dominican Republic, and is distinguished from the other West Indian species by the color of the legs, the number of denticles and the shape of the tarsal claw, and by the shape and the markings on the operculate gills. This species is named in honor of L. H. Rolston, the collector of the type material.

BOOK NOTICE

FLIES AND DISEASE, VOLUME II. *Biology and Disease Transmission*—by Bernard Greenberg. Princeton University Press, Princeton, New Jersey, 1973. XI + 447 pp. \$18.00.

The first volume of this set consisted largely of cross-indexed lists of flies and disease organisms they transmit, with selected references. In contrast, Volume II contains extensive review and analysis of the role of flies as vectors of human (Chapter 4) and animal (Chapter 5) diseases. Together, these chapters comprise nearly 60% of the text. Chapter 1 provides a summary of prescientific attitudes and beliefs concerning flies. Chapter 2 is a review of the biology of selected species of medical importance which have not been treated in the recent literature. Included is a brief discussion of methods for estimating dispersal rates and population sizes. Chapter 3 concerns the fly as a vector, including discussions of morphological, physiological and ecological characteristics pertinent in disease transmission, as well as short discussions of laboratory rearing methods and tissue culture of flies.—Editor.